

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) Apparatus for monitoring an electrical power supply system of a vehicle, the vehicle having a battery and internal combustion engine, an alternator, and a starter; the apparatus comprising:
 - (a) a filter for determining the battery terminal voltage when the vehicle ignition is turned on;
 - (b) a voltage gradient detector for detecting phase and gradient change of the battery terminal voltage when the vehicle ignition is on;
 - (c) a waveform detector for detecting and separating different waveforms when the vehicle ignition is on;
 - (d) an engine-rotating sensor for sensing a speed of the internal combustion engine when the vehicle ignition is on;
 - (e) a processor for processing at least one of the battery terminal voltage, the phase and gradient change, the different waveforms, and the speed of the internal combustion engine for providing an output indicative of a condition of the electrical power supply system.
2. (Currently Amended) Apparatus as claimed in claim 1, further including an output controller for decoding data from the processor to control at least one device; the at least one device includes including one or more selected from the group consisting of a digital-to-analogue converter, a character generator for driving an LCD, a tone generator for driving a speaker, an LED colour pattern generator for driving a colour LED, an infrared printing interface for driving an infrared transmitter, and a computer link interface for coupling to an output port when the vehicle ignition is on.
3. (Cancelled)

4. (Currently Amended) Apparatus as claimed in ~~any one of claims claim 1 to 3~~, further including comprising a temperature sensor for detecting ambient temperature.

5. (Original) A system for monitoring an electrical power supply system of a vehicle, the vehicle having a battery, an internal combustion engine, an alternator and a starter, the system including:

- (a) determining the battery terminal voltage when the vehicle ignition is on;
- (b) detecting phase and gradient change of the battery terminal voltage when the vehicle ignition is on;
- (c) detecting and separating different waveforms when the vehicle ignition is on;
- (d) sensing a speed of the internal combustion engine when the vehicle ignition is on;
- (e) processing at least one of the battery terminal voltage, the phase and gradient change, the different waveforms, and the engine speed; and providing an output indicative of the condition of the electrical power supply system.

6. (Currently Amended) A system as claimed in claim 5, including comprising determining a status of the internal combustion engine, the status being selected from the group consisting of: not running, cranking, running, and normal.

7. (Currently Amended) A system as claimed in claim 6, wherein the status is not running if there is satisfaction of one or more selected from the group consisting of:

- (a) the battery terminal voltage when the vehicle ignition is on is less than the battery terminal voltage when the ignition is off;
- (b) the gradient change is in a range from less than zero to zero;
- (c) a ripple waveform is zero; and the speed of the internal combustion engine is zero; and

wherein the status is cranking if there is satisfaction of one or more selected from the group consisting of:

- (a) the gradient of the battery terminal voltage is lower than a predetermined value;
- (b) the battery terminal voltage with the ignition on is at a predetermined value below of the battery terminal voltage with the ignition off; and

(c) the speed of the internal combustion engine is zero.

8. (Cancelled)

9. (Currently Amended) A system as claimed in ~~any one of claims~~claim 6-to-8, wherein a time duration for the starter cranking the internal combustion engine is determined by one or more of:

- (a) determining the time duration between the gradient change of the battery terminal voltage changing from a significant figure when negative to the significant figure when positive;
- (b) the time duration before and after battery voltage gradient changes;
- (c) the terminal voltage being constant, and
- (d) the speed of the internal combustion engine moves from zero to a positive figure.

10. (Currently Amended) A system as claimed in claim 9, wherein:
if the time duration exceeds a predetermined time, the internal combustion engine will have a poor cranking ability;

if, after the predetermined time, the speed of the internal combustion engine is above a pre-set minimum the engine status is running;
if the ripple waveform is greater than zero, the engine status is running; and
if after the predetermined time the speed of the internal combustion engine is zero, the engine status is that cranking failed.

11. - 13. (Cancelled)

14. (Currently Amended) A system as claimed in ~~any one of claims~~claim 7-to-12, wherein an alternator status is determined from the internal combination engine status and the ripple waveform; and if the engine status is running, and the ripple waveform is zero, the alternator status is malfunction.

15. (Cancelled)

16. (Currently Amended) A system as claimed in ~~any one of claims~~claim 5 to 15, a determination of remaining electrical energy operating time of the battery is made from a consideration of the battery terminal voltage, voltage gradient, the gradient change, and a predetermined end of discharge voltage;

the determination being taken on a regular periodic basis.

17. (Cancelled)

18. (Currently Amended) A system as claimed in ~~claims~~claim 7 to 17 wherein:

if the engine speed is above the pre-set minimum, a ripple factor is below a predetermined maximum, and the battery terminal voltage within an acceptable range, the internal combustion engine status is normal; and

a status of the battery being determined from a consideration of engine speed being above the pre-set minimum, the ripple factor being lower than the predetermined maximum, and the battery terminal voltage being within the acceptable range.

19. (Cancelled)

20. (Currently Amended) A system as claimed in ~~any one of claims~~claim 7 to 19, wherein:

the status of the alternator is determined from a consideration of an ignition pulse frequency, the ripple waveform, the battery terminal voltage, and the speed of the internal combustion engine; and

a battery charge status is determined from a consideration of the ripple factor and the battery terminal voltage; upon the battery being degraded, the ripple factor is greater than the predetermined maximum and the battery terminal voltage is within the required voltage range; and the ripple factor is used to determine a battery impedance status.

21. - 23. (Cancelled)

24. (Currently Amended) A system as claimed in ~~any one of claims~~claim 5 to 12, wherein a ratio of a speed of the alternator to the speed of the internal combustion engine is used to determine the status of an alternator drive belt; the ratio is compared to a highest recorded ratio; and the comparison is below a minimum figure, the alternator is faulty as one phase is not working.

25. - 26. (Cancelled)

27. (Currently Amended) A system as claimed in ~~any one of claims~~claim 14 to 26, wherein the alternator is undersized if the battery terminal voltage is below a predetermined minimum voltage, the engine speed is above the pre-set minimum, the ripple factor is below the predetermined maximum, and the alternator rotation is within an acceptable range.

28. (Currently Amended) A system as claimed in ~~any one of claims~~claim 14 to 27, wherein the alternator is faulty if the battery terminal voltage is above a predetermined maximum voltage, the engine speed is above the pre-set minimum, the ripple factor is below the predetermined maximum, and the alternator rotation is within an acceptable range.

29. (Currently Amended) A system as claimed in ~~any one of claims~~claim 14 to 28, wherein the battery is undersized if the discharge voltage gradient is below a predetermined level, the battery terminal voltage is between a predetermined maximum voltage and a predetermined minimum voltage, the engine speed is above the pre-set minimum, the ripple factor is below the predetermined maximum, and the alternator rotation is within an acceptable range.

30. (Currently Amended) A system as claimed in ~~any one of claims~~claim 5 to 29, wherein:

to determine a cranking circuit quality before an armature rotates, the ratio of the highest recorded beginning cranking voltage gradient to the beginning cranking voltage gradient is recorded as a percentage to show the cranking circuit quality;

the condition of the cranking circuit quality is determined by at least one selected from the group consisting of: the starter condition, the condition of the starter brushes, battery terminal

connection, battery cable connection, battery condition, battery electrolyte condition, and battery impedance; and

the cranking circuit quality is unacceptable when the cranking circuit quality is less than the predetermined minimum required cranking circuit quality.

31. - 32. (Cancelled)

33. (Currently Amended) A system as claimed ~~in any one of claims~~claim 5 to 32, wherein:

a static cranking torque capability of the internal combustion engine is determined by use of: a cranking voltage ratio of the lowest valley voltage to a voltage at maximum power transfer before an armature rotates, converting the voltage ratio to a current ratio, and recording the current ratio as a percentage for the static cranking torque capability of the internal combustion engine;

a determination of the static cranking torque capability is made by at least one of the group consisting of: if the battery is undersized when the cranking circuit quality is acceptable and the static cranking torque capability is below an acceptable limit, if the starter is unacceptable when the static cranking torque capability is below the acceptable limit, if the battery condition is unacceptable when the static cranking torque capability is below the acceptable limit, if the battery terminal is poorly contacted when the static cranking torque capability is below the acceptable limit, and if the battery cable is poorly contacted when the static cranking torque capability is below the acceptable limit; and

upon the cranking torque capability becoming unacceptable the cranking torque capability is less than the predetermined minimum required cranking torque capability.

34. - 35. (Cancelled)

36. (Currently Amended) A system as claimed ~~in any one of claims~~claim 5 to 29, wherein a cranking power capability is determinable by converting a cranking voltage from when an armature commences rotating to an end of cranking to a voltage equivalent of the armature back emf; determining an emf ratio of armature back emf and a maximum power transfer armature back emf converting the emf ratio to a corresponding power ratio; record the corresponding power ration as a percentage to show the cranking power capability.

37. (Currently Amended) A system as claimed in ~~any one of claims~~claim 5 to 29, wherein a cranking power capability is determined by computing the ratio of the cranking battery terminal voltage from when the starter armature commences rotating, to an end of cranking, to a maximum cranking power battery terminal voltage; converting the ratio to a corresponding power ratio, and expressing the corresponding power ratio as a percentage to show the cranking power capability.

38. (Currently Amended) A system as claimed in claim 36 or ~~claim~~ 37, wherein the cranking power capability is used to determine the presence of at least one of:

- (a) starter is malfunctioning when the cranking circuit quality and cranking torque capability are within their respective pre-set limits,
- (b) the battery is undersized when the cranking circuit quality is within limits,
- (c) the battery terminal is poorly contacted,
- (d) the battery cable poorly is contacted, and
- (e) the battery condition is unacceptable when the cranking power capability is below a predetermined minimum required cranking power capability.

39. (Currently Amended) A system as claimed in ~~any one of claims~~claim 36 to 38, wherein the cranking power capability is unacceptable when the cranking power capability is less than the predetermined minimum required cranking power capability.

40. (Currently Amended) A system as claimed in ~~any one of claims~~claim 5 to 39, wherein:

the output is at least one full-colour LED the colour of which is modulated by a plurality of primary colours in an illumination duty cycle according to a voltage ratio of battery terminal voltage under load to no-load, the colour of the LED corresponding the voltage of the battery;

the LED colour is dependent upon the battery terminal voltage; and
upon the battery charge status; and the LED acts as a colour-voltmeter.

41. - 43. (Cancelled)

44. (Currently Amended) A system as claimed in ~~any one of claims~~claim 40 to 43, wherein:

the at least one LED is used to provide the output for one or more selected from the group consisting of: cranking power capability, cranking torque capability, status of the battery, alternator status, and cranking circuit quality; and

upon it being determined that the alternator and battery are in good condition, the LED is reduced to an intensity as a percentage of full intensity, the percentage being in a range from of 0% to 75%.

45. (Cancelled)

46. (Currently Amended) A system as claimed in ~~any one of claims~~claim 5 to 45, wherein:

the output is an audio generator;

the audio generator being used to output an audio signal depending on the quality of one or more selected from the group consisting of: the initial condition, low battery charge, battery over charge, low cranking circuit quality, low cranking power capability, low cranking torque capability, at least one battery cell damaged, and alternator malfunction; and

the audio signal is varied according to one or more selected from the group consisting of: frequency, number of tones, duty cycle, base frequency, and string.

47. - 48. (Cancelled)

49. (Currently Amended) A computer usable medium comprising a computer program code that is configured to cause at least one processor to execute one or more functions to perform the steps of ~~any one of claims~~claim 5 to 48.